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CHEILANTHES WOOTONI MAXON.—This species, lately described from Arizona and New Mexico material, extends also to western Texas, a specimen at hand having been collected at El Paso, by Marcus E. Jones, April 16, 1884, and distributed as *C. Lindheimeri* Hook. Because of their tomentulose upper surfaces, *Cheilanthes Eatoni*, *C. tomentosa*, and *C. Lindheimeri* have not often been confused with *C. myriophylla* or with the several species mistakenly referred to it. They were accordingly omitted from the recent paper¹ dealing with the United States forms associated with *C. myriophylla*.

DRYOPTERIS DRYOPTERIS (L.) CHRIST.—An extension of range is noted in New Mexico specimens recently received from the Biltmore Herbarium, collected in moist thickets near Chama, Rio Arriba County, August 20, 1896, and distributed as No. 3136a of the Biltmore series, the collector's name not stated. The western area of this species has been known to extend from Alaska to Oregon, south in the mountains to Arizona and Colorado, but the plant has not hitherto been reported from New Mexico.

WASHINGTON, D. C.

Fern-hunting in Panama

ELLSWORTH P. KILLIP

The following article relates to the more general features of the fern flora of the Isthmus of Panama. During eight months recently spent in this region I made extensive collections, and specimens of ferns and of grasses and other flowering plants have been referred respectively to Messrs. Maxon, Hitchcock and Standley, of the United States National Herbarium. A number

¹ Proc. Biol. Soc. Washington 31: 139-152. 1918.

of the ferns found are new species, and many belong to genera that need critical study and revision, such as *Selaginella*, *Pteris*, *Tectaria*, *Polystichum*, and *Adiantum*. It is impossible, therefore, to publish at this time a list of the three or four hundred different species collected. A brief account of the various regions visited may, nevertheless, be of interest.

With the city of Ancon, at the Pacific terminal of the Canal, as a center during seven months of my stay on the Isthmus, the territory explored falls naturally under five general headings: Juan Diaz, the Chagres River, Frijoles, the Pacific end of the Zone, and the Island of Taboga. The first three regions are characterized by a dense wet jungle, where, mostly along the banks of streams, an extensive and varied fern flora is to be found; the last two by dry hillsides and open woods, where ferns are scarce. One month was spent among the high mountains of western Panama, where a totally different and extremely luxuriant flora exists.

JUAN DIAZ

The small native village of Juan Diaz is situated upon a river of the same name, some ten miles east of the city of Panama. About a mile beyond this village the dense tropical jungle begins, and some fourteen miles further lies the Pacora River, the limit of the region explored. The jungle is broken at frequent intervals by open prairies, or *sabanas*. A road runs from Panama to Pacora, but only in the months of February and March—the dry season—is it passable its entire length. During the remainder of the year one cannot safely go in an automobile farther than the Tapia River, about four miles beyond Juan Diaz. It is in this region between the Juan Diaz and Tapia Rivers, extending north about five miles and south

to the Pacific Ocean, that most of my botanizing was done. Fortunately I had my automobile with me, and so was able to make about twenty-five trips between the middle of September and the middle of May.

A tropical jungle is well-nigh impenetrable, and the only way to go through it is by following occasional hunting-trails or by wading up and down the countless small streams. One of the best of these trails ran first through a dense palm jungle where various species of *Adiantum* and *Lindsaya*, *Dictyoxiphium panamense*, and *Dryopteris refulgens* predominated, then crossed a couple of sabanas and ran along the edge of "Tree-fern Gully." This was a deep ravine with a narrow stream at the bottom, very rich in ferns. Several specimens of a striking species of *Cyathea* occurred there, as well as unusual species of *Dryopteris*, *Tectaria*, and *Leptochilus*. Great plants of *Maxonia apiifolia*, with huge sterile fronds and strikingly different, skeleton-like fertile ones, were found in abundance, climbing tree trunks. The wet clay banks of the stream were covered with many small ferns, while upon fallen logs various species of *Polypodium*, *Vittaria*, and *Hymenophyllum* were growing. Farther down this stream the handsome *Diplazium grandifolium* became the predominant fern, while at its junction with one of the main branches of the Juan Diaz River, the high rocky banks were covered with species of *Dicranopteris* and *Pteris*.

Another interesting trail passed through a forest, where, in addition to the many ever-present species of *Adiantum*, the most striking fern was *Lophidium elegans*, a fern with sterile fronds greatly resembling a young palm. Among the rocks in the dry sabanas which are met with frequently on this trail, four different species of *Anemia* were found. (*A. oblongifolia*, *A. pastinacaria*, *A. hirsuta*, and *A. humilis*.) Along

the banks of streams in this vicinity the very rare *Dryopteris cumingiana* was collected in great abundance.

The streams of the Juan Diaz-Pacora region fall into two classes as regards the fern flora to be found along their banks. The larger rivers, as the Juan Diaz, Tapia, Tacumen, Tataria, and Pacora, with a width exceeding fifteen feet and a depth of two to five feet (at a time of average rainfall), are characterized by coarse species of *Tectaria* and *Pteris*, and by *Dryopteris mollis*, *D. Mercurii*, *Blechnum occidentale*, *Asplenium obtusifolium*, and the densely tufted *Asplenium formosum*. Probably the most abundant of the terrestrial ferns found in this habitat are *Cyclopeltis semicordata* and the many species of *Adiantum*. On the limbs of trees overhanging these streams are seen the giant *Polypodium phyllitidis* and *Asplenium serratum*, both in outline resembling somewhat our *Scolopendrium vulgare*.

The steep banks of the smaller streams present quite a different fern flora. Two species of *Leptochilus* occur in great quantities, running on the clay soil and climbing over rocks and up trees. The narrow gorges are choked with specimens of the coarse ferns *Danaea nodosa*, *Saccoloma elegans*, *Alsophila blechnoides*, and *Diplazium grandifolium*. Climbing over shrubs and trees is *Lygodium radiatum*, a species nearly confined to the Isthmus.

The first trip was made to this region September 30, 1917, and the last May 12, 1918, so that opportunity was afforded for studying the flora during the succession of seasons. The amount of rainfall increased rapidly from September to November, reaching its maximum about the end of November. In December it fell off considerably; in January there were only two or three showers; in February and the first twenty days of March there was practically no rain at all; while in

April and May three or four hard showers occurred each week. The ferns were naturally affected to a certain extent. Between September and December the epiphytic species of *Polypodium*, *Elaphoglossum*, *Dryopteris*, *Asplenium*, and *Trichomanes* were at their best, December being the month of their maximum fertility. During the dry season these shriveled up completely, and by the middle of March scarcely one could be seen. Of terrestrial ferns the more delicate species of *Adiantum* and *Anemja* followed a similar course. Hardier *Adiantums* and the bulk of the other ferns seemed to be in good condition throughout the eight months, new fronds continually unfolding to take the place of the dying ones. A number of species seemed to attain a certain development toward the close of the rainy season, remain "passive" during the dry season, and rebegin their growth with the first rains of April.

THE CHAGRES RIVER

The Chagres is the most important river in Panama, rising in the eastern part of the Republic (the Darien country), running west through the center of the Isthmus, bending to the north in the Canal Zone and entering the Atlantic to the west of the Canal entrance. The building of the dam at Gatun caused this river to overflow, forming Gatun Lake, the flooded area reaching Gatuncillo some ten miles up the original valley above the channel of the Canal. Above this point the river resumes its natural size, and its course lies through dense tropical jungles from the upper regions which man has seldom visited.

Through the kindness of officials of the Panama Canal, a party of us (all botanists, two being members of the American Fern Society) had placed at our disposal the Hydrographic Station at Ahlajuela, some ten miles above Gatuncillo. In the two days spent here

no adequate study of the ferns could be made, but a five-mile walk through the jungle along the south side of the river from Ahlajuela to El Vigia furnished a general idea of the country. Most of the ferns found here had been seen in greater or lesser abundance in the Juan Diaz country. The trees up the Chagres were much larger in every way than those in the Juan Diaz forests, and consequently there was an increase of epiphytic ferns. Quantities of *Dryopteris patula*, *Elaphoglossum spathulatum*, *Polypodium phyllitidis*, *P. occultum*, *P. polypodioides*, *Vittaria*, and *Ananthacorus* exemplified this.

FRIJOLES, CANAL ZONE

The many short trips which I made in the Pacific section of the Canal Zone between Culebra and Balboa proved so uninteresting from a fern standpoint that I was rather inclined to belittle the whole Zone and concentrate in the Juan Diaz country. In the latter part of January, however, I experimented in the neighborhood of Frijoles along the eastern shore of Gatun Lake. And such a wealth of ferns! Many of the Juan Diaz species were there, while a very great number not found elsewhere on the Isthmus were gathered.

Here let me insert a word of advice to the fern collector who may be "passing through" the Zone with but a day or so for botanizing. Take the train to Frijoles, walk north along the tracks for a couple of miles and explore the ten or twelve little gullies which you will pass on the way. It is a very accessible region and thorough investigation will undoubtedly result in the discovery of many species new to science.

As previously mentioned, the damming of the Chagres River at Gatun caused the waters to flood a vast area and to creep up the countless valleys of streams tributary to the Chagres. The presence of this great body of

water, kept at approximately the same level throughout the year, makes this region independent of the fluctuation of rainfall and results in a most luxuriant vegetation. The railroad swings around the eastern shore of the lake, crossing the many bays on long causeways. As one walks along the track, one comes at frequent intervals upon deep pools of water with gullies extending back from them into the hills. Floating in these pools are logs covered with the coarse fronds of *Acrostichum aureum* and *Dryopteris serrata*, with *Nephrolepis pectinata* and various grasses and sedges intermingled with them. The water in the pools is from fifteen to twenty feet deep, so one must hack one's way by machete through the dense undergrowth around the pool to the valley in the rear. Here ferns of all sizes and shapes are to be found in great profusion. Giant specimens of *Hemitelia*, *Cyathea*, and *Dennstaedtia*, slightly smaller examples of *Tectaria*, *Alsophila*, *Diplazium*, *Dryopteris*, *Leptochilus*, and *Asplenium*, tiny *Polypodiums* and "filmies," all are there. In addition to this luxuriant tropical vegetation, a series of rapids and waterfalls serves to make this a most picturesque and interesting region. At present it is at its best; the waters of the lake have been at their present level sufficiently long to produce a wonderful vegetation, while the hand of man, which has been clearing away the jungle on both sides of this region to make room for pastures, in order that the Canal Zone may be self-sustaining, has not yet touched this spot. The western side of Gatun Lake is undoubtedly of a similar character and will probably remain in its native wild state long after the eastern shore has felt the effect of American energy.

THE PACIFIC END OF THE CANAL ZONE

The small amount of rainfall at the Pacific end of the Zone, as compared with other parts of the Isthmus,

together with the rapid disappearance of the forest, serves to make the fern flora of this region exceedingly sparse. The open woods from Empire and Summit (at the top of the Divide) to the Pacific present a certain sameness in fern flora. Some eight or ten species of *Adiantum*, *Pteridium caudatum*, *Blechnum occidentale*, *Pityrogramma calomelaena*, *Polypodium costaricense*, *P. polypodioides*, *Dryopteris tristis*, *Asplenium auritum*, *Lygodium polymorphum*, and *Dicranopteris flexuosa* make up the great bulk of the ferns.

Ancon Hill, with an altitude of about 650 feet, is situated on the shore of the Pacific near the Canal entrance. The lower half of the hill is occupied by the towns of Ancon and Balboa; the upper half consists partly in dry fields and partly in woods. In addition to many of the species mentioned above, three rather noteworthy ferns were found on the hill: *Adiantum filiforme*, *Anemia oblongifolia*, and a species of *Lindsaya*.

TABOGA

The island of Taboga, situated in the Pacific some twenty miles off the mainland, lying similarly in the "dry" belt and consisting largely in grass-covered hills and more or less open woods, is not of great interest to the fern collector. In addition to the ferns usually characteristic of this habitat there occur on the island quantities of *Nephrolepis biserrata* and *N. exaltata*, found chiefly on palm trees, *Dryopteris longifolia*, and a rather large *Polypodium*, possibly new.

EL BOQUETE, PROVINCE OF CHIRIQUI

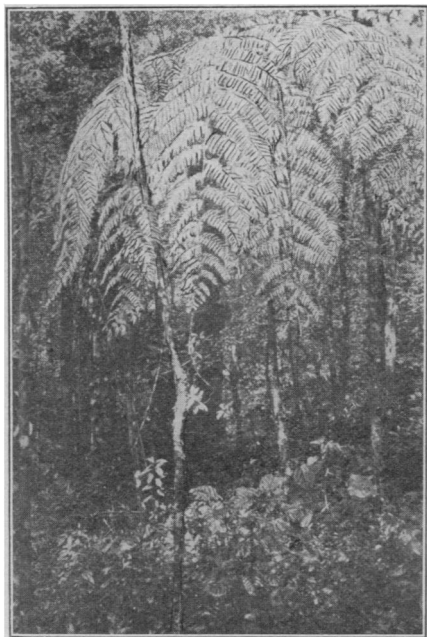
One of the most interesting regions for ferns on the whole North American Continent lies among the mountains of the Cordillera, between the Provinces of Chiriqui and Bocas del Toro, in the western part of the Republic of Panama near the Costa Rican boundary. The

village of El Boquete is situated at an altitude of about 4000 feet at the foot of Chiriqui Volcano and about forty miles from the Pacific Ocean. The Chiriqui railroad, extending from the seaport, Pedregal, to Boquete, ascends gradually through dry prairies to the forest-covered mountains, following first the Rio Chiriqui and then one of its most important branches, the Rio Caldera.

With the Hotel Lino, two miles above the village of Boquete, as headquarters, I spent the greater part of the month of February botanizing among the mountains. Four or five trips of one day each were made along Holcomb's trail up the Rio Caldera for a distance of ten to twelve miles; four trips up the valley of the Rio Piarnasta and over the newly-cut Roballo trail to the east of Boquete; one along the Horquete Range; one of three days along Holcomb's trail to the summit of the Divide and down the Atlantic side; and one of three days to the top of Chiriqui Volcano, 11,000 feet high.

The valleys of the Caldera and Piarnasta lie in a very wet belt. Almost every afternoon a fine mist blows over the Divide and keeps this region in continual moisture and epiphytic ferns naturally are in very great abundance. Although the volcano lies in the dry belt, south of the main cordillera, a number of very interesting ferns were found on the way up and on the barren rocks at the summit.

From the fern standpoint the most interesting trip was that over Holcomb's Trail to the Divide. This trail was originally planned to extend from Boquete to the United Fruit Company's property at Bocas del Toro, but after reaching the top of the Divide and extending a short distance down the Atlantic side, was left uncompleted. The trail is not kept open and the two camps—one situated some twelve miles from Bo-



CYATHEA DIVERGENS KUNZE.
HORQUETE MTS., PROVINCE OF CHIRIQUI, PANAMA

quete at the foot of the Divide, and the other several miles over the Divide on the Atlantic side—are in a state of complete ruin. A new camp has, however, recently been built a couple of miles south of the earlier Camp I, and this we made our headquarters. To avoid confusion, I have called this new camp Camp A, designating the site of the earlier one as Camp I.*

As I had “combed over” quite thoroughly the region in the vicinity of Camp A on previous trips, our entire time was now spent north of Camp I. My guide opened up a hunting trail, long disused, leading from Camp I to the top of the Cordillera, extending along this a few miles to the east (with a view of the Pacific on the right and the Atlantic on the left), and then descending the north side a short distance. At every few feet of ascent a brand new lot of ferns would appear. My guide would open up my press while I would walk about within a radius of a few yards and gather a generous number of specimens of each species. As soon as we had amassed a sufficiently large bundle, we would tie it up and leave it by the trail to be picked up on the return trip. The accompanying photograph shows my guides in the densest part of this jungle.

The intensely humid character of this portion of the forest is almost beyond description. The whole atmosphere was wet and clammy and bubbles of yellowish water were slowly collecting and dripping off the tips of the ferns. The tree-trunks were covered with moss and masses of filmy ferns, all as saturated as the wettest sponge.

After spending two days in this portion of the Cordillera, we followed Holcomb's trail itself to its summit and down the Atlantic side for three or four miles.

* The localities along Holcomb's Trail have been discussed briefly by Mr. Maxon in a paper entitled, “A Remarkable New Fern from Panama,” *Smiths. Misc. Coll.*, Vol. 56, No. 24, pp. 1-5, pls. 1-3, Nov. 22, 1911.



MY GUIDES IN THE HUMID FOREST OF THE CORDILLERA, PROVINCE
OF CHIRIQUI, PANAMA

A somewhat less intensely humid forest was here met with, and the fern flora was slightly different from that of the two preceding days.

The great quantities of ferns collected in the Cordillera region of Boquete have not yet been determined, so detailed mention of the species must be deferred. On some future trip to Panama I hope to have an opportunity of exploring the Darien region, that vast, little-known country lying near the Columbian boundary, containing Indian tribes, through whose territory passage has been persistently denied to the white man.

In conclusion I certainly must express my very great gratitude to Mr. William R. Maxon for determining the ferns collected, as well as to Mr. A. S. Hitchcock and Mr. Paul Standley for going over other botanical specimens gathered. I very greatly appreciate, also, the kindness shown me by the Panama Canal officials, and by Mr. H. J. Watson and Col. and Mrs. E. H. Cuthbert, of Boquete.

ON BOARD S. S. "PANAMA,"

EN ROUTE TO NEW YORK, MAY 28, 1918.

Texas Pteridophyta—I.

ERNEST J. PALMER

While making general collections of plants in the Southwest for the Missouri Botanical Garden and Arnold Arboretum during the past few years, I have had an opportunity to observe many of the ferns of Texas in their native environments and to note their distribution over wide areas. Although the present list, perhaps, adds nothing new, unless it be *Lycopodium*, to the reported fern flora of the state, it may be worth while to place on record a number of new localities for some of the species.